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AUTHOR Weible, David M.
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ABSTRACT

A review of the literature and current technology focuses on the determination of what strategies and methods are appropriate for computer-assisted language learning (CALL). A brief overview is presented regarding the historical development and non-use (to its full potential) of the computer in the education field, and particularly in the area of foreign language learning. Three unique qualities that the CALL approach offers are discussed: (1) computers are able to structure the student's interaction with the subject matter and present and teach learning strategies; (2) unlike print, computers are process-oriented, a quality that could be very helpful in avoiding the need for reliance on grammatical terminology in teaching various features of the target language; and (3) the computer is able to modify the presentation of instructional material to meet an individual learner's needs and/or abilities. (CB)

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Towards a Media-Specific Methodology for CALL

David M. Weible
University of Illinois at Chicago

Introduction

The focus of this chapter is the determination of what strategies and methods are appropriate for the computer on the basis of its media characteristics. If one stops to think about it, the growth and development of the use of computers since their invention is simply astounding. Were all the computers now in use to disappear overnight, most of the services taken for granted—telecommunications, banking, etc.—would break down completely, and society would experience total disruption. One of the areas where the effect would not be so noticeable, however, is the field of education.

The use of computers in education remains unimpressive, both in terms of the quality of the software and its impact on efforts to improve learning. This is particularly so in the area of foreign languages (Baker, 2). As to why it is so, a major reason must be the general failure of software writers to exploit the computer's qualities fully. They have failed because they have persisted in treating the computer as a substitute vehicle for existing instructional techniques and methodologies. That they should do this is quite in keeping with the observations of one of the first students of the characteristics of media, Marshall McLuhan.

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David M. Weible (Ph.D., University of Kansas) is Associate Professor of German at the University of Illinois at Chicago where he is also Director of the Audio Information Service/Language Lab. Recipient of an Exxon Education Foundation grant in 1975–76 to develop courseware in German for the PLATO system, he is currently Editor of *Die Unterrichtspraxis* and has served as a consultant in technology and multimedia instructional packages for the Goethe-Institute, the U.S. Department of Education, and others. He is a member of ACTFL, AATG, CALICO, and the International Association of Learning Laboratory Directors (IALLD).

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McLuhan's dictum, *the medium is the message,* has been a commonplace for twenty years (McLuhan, 13). The truth of this notion seems to be supported by the various phenomena attending the shift in orientation from printed to pictorial media that has taken place throughout the modern industrialized world. The rise in popularity first of the cinema and then of video has had a profound impact on our culture, particularly upon the educational process. The relative decline in significance of the word (written or spoken), the decreasing ability to perform abstract analysis, and the corresponding increasing emphasis placed on visually oriented conceptualization are regarded by many as signs of cultural impoverishment. This helps to explain why education, particularly at the college and university level, has generally been slow to embrace computers (Olsen, 15). Some educators, perceiving computers to be more for the visually than the verbally oriented, fear that their widespread introduction in education may, instead of aiding in the learning process, lead to its further degradation.

To a certain extent, this battle has been joined once before. McLuhan saw the rise in interest in teaching machines in the early sixties to be a side effect of the impact of television on society.

> One of the major pressures of TV has been to encourage the "teaching machine." In fact, the devices are adaptations of the book in the direction of dialogue. These teaching machines are really private tutors, and their being misnamed on the principle that produced the names "wireless" and "horseless carriage" is another instance in that long list that illustrates how every innovation must pass through a primary phase in which the new effect is secured by the old method, amplified or modified by some new feature (p. 292).

There are a number of points of interest in this quotation that one can relate as well to the computer and its milieu. The description of the teaching machines of twenty years ago as an "adaptation of the book"—thus primarily a text-oriented medium—"in the direction of dialogue"—through a limited sort of interactivity, with student responses generally of a true–false or multiple-choice nature—seems to fit much of what is seen in present-day computer-assisted instruction materials. Moreover, the misnomer "teaching machine" was for McLuhan a further instance of a process that occurs with any major innovation, that is, the unavoidable tendency to explain, name, and view the innovation as simply a modification of an already familiar device or method—a tendency that delays the full perception of the innovation's true characteristics and potential.

In their turn, computers as an educational medium also have to go through an initial phase of discovery. One aspect of this phase has been the association of the hardware with the earlier "teaching machines" and

computer-assisted instruction with the instructional methodology associated with them: programmed instruction and the emphasis of rote drill and practice over cognitive interaction. Over twenty years ago, Nordberg (14) indicated the use of teaching machines under these six dangers:

1. Whatever lacks abstract intelligence is not able to initiate, transmit or receive ideas. . . . The most that a machine can do is take concentrated symbols built into it by an intelligent being and rearrange them according to a schema also built into it by somebody. Thus governed, the machine can tell a pupil that he has or has not the "right answer," but it cannot deal with interpretive problems that might arise beyond what has been programmed into it.
2. Whatever cannot deal with paraphrasing is somewhat handicapped for meaningful teaching. Educational psychologists generally agree that the two best proofs of meaningful, solid learning are paraphrasing and application. Machines can deal with applications only in an isolated, superficial way, and they have yet to do much with paraphrasing. . . . A teaching machine will penalize a student who has the right idea but the "wrong" words, and reward one who has memorized the "right" words but has the wrong idea. Therefore, they are somewhat handicapped for meaningful teaching.
3. Whatever cannot deal with organization and expression of knowledge is handicapped for meaningful teaching. Most educators agree that, beyond such arbitrary meanings as the alphabet and numbering system, to arrange and articulate one's knowledge in a holistic way is of the essence in learning. But machines cannot deal with organization and expression of knowledge. That is because they must be "objective" in the same sense as an "objective test," that is, a test that anyone with the key can grade with the same results as anyone else. All programs for automated learning that the writer has seen deal with rather trivial bits and fragments of knowledge, and it is hard to see how it could be otherwise. The creed of the machine, as of those who find machines fascinating, is that everything is the sum of its parts.
4. Whatever encourages preoccupation with details poses dangers for meaningful teaching. Facts, parts, data, are necessary but acquire meaning only in relation to ideas, patterns, the whole. . . . But machines encourage preoccupation with details, for reasons already argued. Therefore, they pose dangers for meaningful teaching.
5. Whatever leads towards a nationalized curriculum discourages creativity and thought in some fields. Experience suggests that nationalized educational systems are invariably mediocre. Standardization is never the royal road to genius! But teaching

machines lead towards a nationalized (and almost certainly secularized) curriculum.

6. Whatever minimizes the importance of the sheer metaphysical presence of the teacher jeopardizes good teaching. For, teaching is essentially the confrontation of two intelligences, and tends to be more effective when that confrontation is flexible and direct. When a teacher is smiling at *me*, looking at *me* (not an *image* of a teacher on a TV screen or her alter ego in the gears and pulleys of a machine) this is something irreplaceable. Naturally, mechanists do not understand how this could be, and regard those of us who have any criticisms of teaching machines as incompetents who fear to lose our jobs (pp. 1–4).

Against all of this Nordberg could find only one positive attribute of the teaching machines of his day. He noted that anything that facilitated individualized drill can aid in teaching *arbitrary meanings*, "those facts and concepts which from the standpoint of the learner at the time he learns them, have no rationale. The cannot be anticipated or deduced; they must simply be experienced and committed more or less blindly to memory" (14, p. 5).

What perhaps surprises one most while reading these six dangers (and the one advantage, as well) is how easily they could be applied to the CAI (computer-assisted instruction) programs of today. This is surprising because computers are far more sophisticated and powerful than the teaching machines of twenty years ago. Unfortunately, that additional power and sophistication will remain largely unavailable to language teachers until a substantial body of CALL (computer-assisted language learning) software is created that makes full use of the computer's potential as an instructional medium. This will not be so easily done. As McLuhan observed, people are slow to perceive the true nature of innovations precisely because they go beyond everything with which they are familiar. In order to get some idea of the sort of mistaken assumptions and wrongheaded uses likely to be made of the computer, consider the development of another modern communications medium that has been around for most of this century: the cinema.

The Development of Cinema

In the years preceding the advent of sound in motion pictures, it was taken for granted that the visual element should dominate in the telling of the story. The use of words was restricted to the occasional appearance of "titles." When sound was added in the late 1920s, it exercised a great novelty appeal, even though the use to which it was put was hardly original.

For example, music in the sound track often simply replaced, albeit on a grander scale, the performance on the movie house's organ or piano.

Another change brought by the addition of sound to the cinema was the opening of the realm of "sound effects." It should be noted that truly creative and original uses of sound effects were slow in coming to the movies. On the whole, directors and their audiences were extremely pleased if the sound track succeeded simply in reproducing the most basic effects (bells, whistles, gunshots, etc.) with acceptably close synchronization to the image. The rise in popularity at this time of the detective/police/gangster genre may be in part attributed to the popularity of the rather obvious sound effects that accompanied them—a further illustration of the medium being the message (Geduld, 6, p. 266).

Nevertheless, many wholly unnatural and inappropriate uses of sound remained common practice for a decade or more into the sound era. To some extent, that was due to the primitive technology of those early days. For example, whenever someone entering a room closed the door behind him, absolute silence ensued—all noise from outside was totally shut off. Now, given the presence of a moderately lively party going on beyond that closed door, one would normally expect to hear at least a faint murmur of conversation, even with the door shut. However, this expectation went beyond the capabilities of the early sound systems. They were not up to producing clearly audible faint murmurs due to the high level of ambient hiss and splutter generated in the primitive recording process.

The most vivid and dramatic advantage of sound movies over silent ones was the ability it gave the actors to speak their lines instead of miming them. This opportunity was seized with a vengeance, and the "talkies," as they were called, became very talky indeed. Mystery/detective melodramas benefited from this development as well.

> They offered superabundant opportunities for talk and noise, for stretches of dialogue in which police and detectives [or] gangsters and other villains sometimes strained the patience of audiences with long-winded explanations or self-revelations; for interminable courtroom scenes (Geduld, 6, p. 266).

On a loftier artistic plane, many leading stage actors were now attracted to the cinema for the first time. Witty dialogue, snappy repartee, and just plain chattiness became leading characteristics of the films of the thirties and forties. Many of these films, too, have a rather theatrical quality, as though this new medium were to be regarded as an electronic and more modern version of the stage—a further instance of an innovation's nature being masked by a seemingly near relation (Geduld, 6, p. 253; Robinson, 17, p. 167). In that sense, the motion picture medium can be said to have suffered from an identity crisis at this point in its history, a point where, in the opinion of some, it was just beginning to find itself as an art form

(Geduld, 6, p. 222). The visual element continued to be of importance, but in very many cases it served primarily as illustration for the spoken word. One aspect of the medium by virtue of its novelty had assumed an exaggerated importance.

In the last two decades, there has been a significant shift away from this position so that now, more often than not, image (together with music and sound effects) generally dominates the verbal element. The nature of that image has itself undergone a number of transformations due to technological changes. The traditional square visual field gave way in the fifties to new wide-screen formats. These encouraged the use of sweeping panoramic photography. More recently, there has been a move back to more intimate, close-up photography with little of significance taking place on the edges of the visual field, a trend that has resulted from the increasing impact of television in the marketing and distribution of motion pictures.

The Development of the Computer

As McLuhan observed, any new medium must undergo this process of definition. The process is a rather slow one for two reasons. The more radically new the medium, the more unknown it is and, consequently, the longer it takes to explore its possibilities. Also, ongoing technological advancements expand the range of possibilities continually necessitating additional experimentation and exploration, just as sound did with the cinema. Can it then be any wonder that considerable uncertainty remains with regard to the computer's potential for instructional applications in language learning? The computer is quite possibly the most radically new information medium mankind has ever invented. Moreover, improvements in computer hardware and systems design follow one another with tremendous rapidity, forcing constant redefinition of the computer's capabilities. It started off as a data processor, pure and simple. The addition of a cathode ray tube display device (CRT) and full screen, text-based direct input and output (I/O) produced something of an identity crisis in this medium as well, focusing more on the computer as a booklike purveyor of textual information and drawing attention away from its data-processing powers. More recently, the computer has drawn even more popular attention to itself as a game-playing device, both in the home and in so-called video arcades. Given these very different perceptions of its character, how can one get a clearer notion of this new medium?

Perhaps a sensible course would be to ask not what the computer can do, but rather what do we want it to do—operating on the hopeful assumption that, with time, it may be able to do virtually anything. That, however, is not very practical in the short run, in terms of the design and execution of programs we wish to see implemented as soon as possible. Moreover, one

would then also have to assume as a corollary that the computer has no intrinsic media qualities, that it is infinitely adaptable, while we know this is, at least at present, far from being true. As Schank (19) points out:

> The operations that a computer can execute are embodied in the programming languages it can understand. Any time you wish to break new ground in computer understanding you have to figure out how to explain everything to the computer in terms it already can understand, namely, a programming language at a lower level (p. 77).

Schank then goes on to observe that while a programmer "is someone who is familiar with the levels of understanding which computers so far have been given" and a computer scientist is "someone who attempts to find new ways to get computers to execute programs more efficiently or new ways to enable people to communicate with computers more effectively," researchers in artificial intelligence are attempting to "raise the level of understanding that computers have" (p. 77). Once they succeed in this, quite a lot may be expected from CALL.

Even at present, however, a good deal more can be expected from computers than from the teaching machines of yore. "The choice is not simply between mechanical drill at one extreme and human-like simulated intelligence at the other" (Underwood, 21, p. 47). There are, in fact, "many in-between levels of partial understanding, what we might call 'semi-intelligent systems,' that can be extremely useful as interactive instructional aids" (Underwood, 21, p. 47). Unfortunately, to judge by most of the material produced for CALL to date, one must conclude that these "in-between levels" have been consistently set too low.

This low-level focus can be explained in part by the reasonable excuse that a good deal of time must elapse between the formulation of a concept and its practical implementation. The CALL software currently available in the marketplace represents the conceptual level of one or two years ago. The danger posed by the existence of these programs, many of them being marketed by reputable publishers in the field of foreign language education, is that they may be regarded mistakenly as models to be emulated when, in fact, they should be subjected to the severest scrutiny.

That is so because users of CAI allow the present capabilities of the medium to define their expectations. Actually, it is worse than that; in reality, the *perception* of present capabilities of the medium is allowed to define expectations, and this perception is too often based on a limited view of the computer as a data processor and, perhaps, an electronic book, when in reality it is much more than that, and essentially different. Even a realistic assessment of the medium's present capabilities is insufficient because, as was noted earlier, these capabilities are being expanded at such a dizzying rate that it is unwise to permit current capabilities to limit current expectations. Whoever will attempt to write useful instructional

software must strive constantly to achieve the maximal appropriate utilization of present-day technology, guided by an apprehension of immediately foreseeable developments.

Admittedly, just what constitutes *appropriate* utilization is a debatable issue and relates to the still larger questions of second-language acquisition theories and their significance for the design and implementation of CALL materials. There may well be, as Higgins and Johns (9) suggest and Underwood (21) maintains, major arguments against using traditional programmed instruction modes. These may indeed, in Krashen's (12) terms, contribute to *learning* more than to *acquisition*. Just how important that really is, in terms of facilitating (or retarding) the acquisition of second-language competence, while an issue of great importance, is peripheral to the topic of this chapter, whose focus is on what constitutes appropriate utilization exclusively with reference to the qualities of the computer as an instructional medium.

Three Unique Qualities

To be specific, there are three particularly important qualities that no other instructional medium possesses and that developers of CALL materials have as yet largely ignored: First, computers are able to structure the student's interaction with the subject matter in a precise manner; that is, they not only present the subject matter but are also capable of presenting and teaching learning strategies. Second, unlike print, which is an essentially static, fixed medium, computers are process-oriented, a quality that could be very helpful in avoiding the need for reliance on grammatical terminology in teaching various features of the target language. Finally, when programmed properly, the computer is able to modify the presentation of instructional material to meet an individual learner's needs and/or abilities. At the same time, programs which utilize this ability could also become valuable sources of new data on how second languages are learned, given appropriate data collection and evaluation procedures (a topic developed by Pederson in Chapter 5 of this volume). The sections that follow discuss each of these qualities in some detail and offer recommendations for authors and teachers who would use CALL software in their classes.

Structured Interaction

Perhaps the most striking difference between computers and other instructional media is the fact that the computer's operation is governed by a program. Its presentation of instructional material embodies a programmatic approach to that material; that is, *it defines precisely the nature*

of the student's approach to and interaction with the subject matter. As Steinberg (20) notes:

> The CAI author must make instructional and managerial decisions that are not an issue in other media. A textbook author may insert questions or problems in the book but does not have to decide how many questions the student should answer. The student or the instructor decides. The CAI author does have control and must decide not only how many questions to ask, but whether to force the student to answer them and whether to require a given level of mastery before allowing the student to proceed. Clearly, the author has many more decisions to make than how to present the lesson content (p. 5).

Admittedly, the degree to which the program affects the student's interactions with the subject matter varies greatly and depends on the design goals of its author. A "page-turning" lesson, one that simply presents successive pages of information for the user to read, is the lowest degree of interaction and, in fact, hardly provides it at all, but one might also argue that—in terms of its media-specific impact—such a program is not really a computer program, for it does not utilize the capabilities of the medium to any significant degree.

But even programs of the flash-card drill variety that are only slightly more ambitious than the "page-turners" suggest things to the student about the nature of second-language learning that the program's author most likely never intended. The author may have wished simply to provide an aid to vocabulary memorization and, to do so, transported the familiar flash card format to the computer. This seemingly innocent translation of a given methodology from one medium (print) to another (the computer) is, in fact, cause for serious concern. Any student using traditional printed flash cards is free to use them as he or she sees fit. The number of flash cards to be done, whether or not to randomize their appearance, whether or not to review missed items, whether or not to cheat, all this is left entirely to the student's discretion. And perhaps most importantly, no undue significance is placed on the role of flash-card drilling in language learning. Students who feel that such aids help them can use them, others do not.

However, when this drill approach is "computerized," a number of things happen. Students seem, at least at the beginning, to find working with them more interesting than working with printed flash cards. As Hope, Taylor, and Pusack (10) put it, "by having each item pop up as though from nowhere, and by responding in some way to the student's answer, the program transforms otherwise inert exercises into active material" (p. 3).

At first glance, this may seem to be a justification for producing such

programs. After a bit of thought, however, one can see that the student's reaction is actually rather worrisome. Computerized flash cards possess no intrinsic advantage over printed ones. Indeed, their lack of portability is a disadvantage. Why then do students respond to them more enthusiastically? Clearly, they are being seduced by the medium itself. Increased familiarity with computers will doubtless lessen this effect eventually, but at present there can be no doubt that many, probably most students find working with computers on instructional tasks fascinatingly novel. Computers occupy a special position in their imagination, and they interact far more intensely with them than they do with print media.

Again, this "attraction" seems to speak strongly for the use of computers in instruction. But it must also serve as a warning to authors (and teachers) to be careful of methodological design. The casual, occasional use of printed flash cards may indeed be helpful to some students in their study of a foreign language. But the programmatic use of a flash-card mode in an intense drilling situation is likely to reinforce in the learner certain common and counterproductive assumptions about the nature of second-language acquisition.

The programmatic determination of word meanings through the memorization of paired associate items devoid of contextual reference strengthens the naive learner's tendency to view reading comprehension, for example, as a decoding exercise with each lexical item to be decoded in turn until the entire sentence is revealed. This approach may work fairly well for students at the outset of their foreign language studies, but with time it becomes a significant barrier to progress, not only in reading but in speaking and writing as well. One has to doubt the value of any instructional program that pumps the user full of information in such a way as to render its integration into a broader overview of the subject matter more difficult (Nordberg, 14, p. 3).

In short, when students use a CALL program, they tend to learn its methodological approach as well as the subject-matter elements it contains. What is more, the prolonged use of a program tends to program the user. Evidence of this phenomenon is perhaps found most easily in the improvement in performance of video game players. A video game is really an interactive structure, and the players do increasingly better in the game as their knowledge of the game's structure and its hidden rules improves. Both the speed and the accuracy of their responses benefit by continued exposure. Similarly, it is possible for a CALL lesson to present, along with the obvious subject matter, a "hidden agenda" consisting of useful approaches to facilitate the student's learning and/or acquisition of new features of the target language. Thus, the use of CALL materials could have an effect that would carry over into the student's work with the textbook, in the classroom, and even in an unstructured target language environment. Insofar as teaching students to learn rivals in importance teaching them subject matter, every effort must be made to see that CALL

lessons incorporate and inculcate appropriate learning strategies so that the students who use them will be, so to speak, programmed for successful language study. Just as important, care must be taken that inappropriate or even counterproductive learner behaviors not be incorporated inadvertently into CALL materials.

What is the best way to do this? First of all, the author in testing out his or her material must observe carefully the behavior it produces in its users and make sure that this behavior is desirable from the point of view of learning psychology. Weible (22) gives an example of the importance of this. A principal instructional goal of a German reading program was to teach the students to infer the meaning of unknown lexical items from contextual indications. The students were presented with a series of reading passages. They were to read the text through, inferring the probable meanings of the German items from their (known) context, and then test their inferences on an item-by-item basis.

The program's initial design suffered, however, from a critical flaw. Following the classic tenets of programmed instruction, the student who failed to infer the word's meaning correctly was immediately given the correct answer as a form of positive feedback. Observation of actual student behavior showed, however, that while some of the students were using the material as intended, others had discovered they could get through the material without having to try to infer the meaning of any of the items. All that was necessary was to ignore the reading passage entirely, enter any sort of nonsense in the item-checking section, copy down the correct answers as corroborated for each item, then run through the item-checking section once again, plugging those same answers as needed into the appropriate items. While students had not altered the program's apparent purpose of teaching certain new vocabulary items, they had subverted completely the more important pedagogical aim of the program—teaching the contextual dependence of word meanings.

A CAI program must reflect its author's pedagogical intent faithfully. In this case, the program was subsequently altered so that the student had either to achieve a correct response rate of at least 33 percent or to have already passed twice through the item-checking section unsuccessfully before help would be given in the form of correct answers. This, plus a few other minor changes, ensured that the pedagogical goal of the material would be achieved by its users (Weible, 22, p. 490).

The ability to do this, to structure the student's interaction with the material in a precise and detailed manner, is surely a major aid in achieving and implementing a coherent instructional design. Does doing this make the computer, to use Higgin's (8) term, a *magister*?

> The *magister* wears a gown to show that he is qualified. He is paid a salary every month. He carries a stick, real or metaphorical, with

> which to beat the children who give wrong answers. He makes assessments: right or wrong, good worker or lazy student. Most important of all, he chooses the order in which things happen, what is to be learned, and what kind of activity the learners will carry out. . . . For years people have been trying to turn the computer into a *magister*. They do this by making it carry the learning system known as Programmed Learning (PL). Underlying PL is the belief that a body of knowledge can be reduced to a set of very small steps, each of which is easily learnable. Each step is turned into a frame which contains a line or two of exposition and a comprehension question. PL in fact does not need a computer or any other machinery; it can be used just as effectively in paper form, and computers which are used exclusively for PL are sometimes known disparagingly as page-turners (p. 4).

Note that Higgins echoes one of Nordberg's dangers, the concern regarding the underlying belief of programmed learning (or programmed instruction) that a body of knowledge can be reduced to a set of very small steps, that the whole is nothing more than the sum of its parts. Higgins seems to equate the determination of the instructional goal and methodology (principal characteristic of the *magister*) with the utilization of one specific methodology, programmed instruction. This may simply be his reaction to that body of CALL lessons that, in fact, do imitate in a most unimaginative way the approach of the programmed instruction texts and machines of decades ago. At any rate, Higgins sees another role for the computer as preferable: the role of the pedagogue, or less ambiguously, the *paidagogos*—the Greek slave who escorted the young master to school.

> When the young master snaps his fingers, [the slave] comes forward to give information, answer questions, or perhaps, if that is what the young master wants, to conduct an argument or give a test. He may be expert, but his expertise only emerges on demand (p. 4).

The chief reason Higgins gives for his preference that the computer play the role of *paidagogos* rather than *magister* is as follows:

> At many stages of learning we need and expect a magisterial approach. But an exclusively magisterial method, particularly one undertaken with a large class, entails that the teacher does nearly all the initiating and the learners get practice only in responding. Such one-sidedness can have practical and motivational drawbacks (p. 4).

This objection does not really cover the various qualities he ascribes to his *magister*. In particular, the computer as *magister* does not typically deal with a large class but rather with the individual learner. One has to wonder

whether the real concern here is not that the computer may become too magisterial in a broader sense, even dictatorial, evoking the idea of "big brother."

Steinberg (20), too, admits to an objection to computer control of instruction, but hers is the pragmatic concern that "computer control is more costly than learner control" (p. 97). While she notes that many CAI authors believe that giving the student control of the learning process will improve student achievement, she doubts this to be the case.

> For the most part, only adults who are high performers in the subject will be skillful managers of the sequence of instruction and will perform equally well (not better) under learner than under computer control. Other students usually perform worse under learner than under computer control. Experience and research are in agreement with common sense. If a student knows little or nothing about a subject, how can you expect her to choose a reasonable sequence of topics (p. 98)?

Unfortunately, Steinberg does not give a specific reference to the research studies that support this claim. Still, it seems a reasonable one, granting the assumption that the pedagogical and methodological aspects of the program are well taken care of. The computer can indeed function as a *magister*, but it need not do so in the limited and limiting way described by Higgins. To see why this need not be so, those other qualities the computer does not share with the print media must be addressed. Moreover, as shall be seen below, it is possible to give the student indirect control of the program, i.e., control of variables such as sequencing, level of difficulty, length of study, etc., which the student controls through interaction with the lesson.

The Process Orientation of the Computer

A second quality often overlooked is the fact that computers, unlike books, are process-oriented. The heart of a computer is its "central processing unit" (CPU). The primary use of the computer is as a data processor or, in the case of verbal "data," a word processor. A computer "spreadsheet" does not merely display columns of figures; it calculates them according to the relationships and formulas specified by the user. If an entry is altered for any reason, all of the totals resulting from that entry can be reprocessed speedily and automatically.

The ability of computers to process data rapidly also permits them to simulate processes. There are, for example, computer programs that offer realistic simulations of piloting a plane, performing chemical titrations,

and breeding generations of fruit flies. This ability could be put to good use in CALL materials as well.

The most obvious analogy are programs that would simulate actual target language usage and permit the learner to apply it more or less communicatively. Programs such as *Spion* (Sanders, 18), *Familia* (Underwood, 21, pp. 75–79) and *Die Programmiersprache SuperPILOT* (Harroff, 7) are all very promising beginnings in this direction. However, they are extremely complicated programs and, with the possible exception of *Familia*, may seem to most classroom teachers to deal with instructional points of only marginal interest. Perhaps of more interest to many teachers would be the use of the computer as a tutorial instructor.

The ability of computers to simulate processes also means that those aspects of language learning that relate to linguistic processes or processlike linguistic features, such as the derivation of a new and unfamiliar form, either lexical or morphological, from a known one, can be presented directly, as a process. Where the medium of print limits the user to the description of processes, quite often utilizing a highly specialized terminology that itself, until it is mastered, represents a barrier to understanding, the computer permits the author quite often to display the process as a process, without extraneous commentary.

Most regrettably, not much use of this ability has been made to date in foreign language instructional programs. One example, however, is provided by some CALL materials Ariew (1) has authored. To explain the formation of the imperfect tense, first a first-person plural form is shown, then the stem is derived by blanking out the personal ending, finally the various imperfect endings are appended sequentially to the stem in conjunction with the appropriate personal pronouns. Where this differs significantly from a textbook presentation is in the total avoidance of grammatical terminology or indeed of an explanation of any kind. The learner observes the process, analyzes it, and then imitates it. The attempt to acquire a new concept through the use of a grammatical metalanguage that may itself be largely meaningless to the user is here replaced by a dynamic representation of the process, forcing learners to discover how it works on their own.

Of course, the objection can be made that grammatical terminology should be taught, that the learning of abstract grammatical concepts is in itself an important part of foreign language instruction—a view that may have fallen somewhat out of favor, but is doubtless still widely held (see Chapter 7 by Garret in this volume). The students can, however, always be taught the formal description of a linguistic feature *after* they have already acquired practical mastery of it. Most important, surely, is the likelihood that this use of the computer may greatly facilitate the acquisition of new language concepts, particularly those that find no parallel in the learner's native language. If we have indeed become a more visually oriented culture, then clearly computers with their ability to use animation along with

color and sound are at a great advantage over textbooks in the presentation of some features of a foreign language, for example the teaching of morphology, accidence, concordance and other formal aspects of language learning whose textbook exposition seems, at least in the United States, to meet increasingly with blank incomprehension.

Automated Individualized Instruction

A third quality of computers as an instructional medium that should be observed by authors who wish to ensure that users of their lessons become better language learners is the ability to provide for maximally efficient use of the material by different kinds and levels of students. In the best instance, the author will provide the program with the ability to "learn" about the individual user's needs and to act on this "knowledge" by modifying the presentation of the subject matter. This modification may be no more than having the program "interrupt" itself to provide advice (Chambers and Sprecher, 4, p. 124). A more extreme variation of this would have the program modify the order and/or manner of the presentation of its content in response to indications it has been programmed to pick up from the student's performance. This effect can carry across between programs on different diskettes if they have been designed to have a common student database and if there is some means of collecting individual student data independently of the lesson disk, whether through the use of a second "floppy" data disk or the incorporation of a centralized hard disk storage unit. In this manner, the student will contribute to the ultimate form of the program as he or she encounters it—that is, the student, while being "programmed" by the program, will also exercise a sort of programming power over it and be able to alter it to his or her greatest educational advantage, so that the end result will be a synthesis of the author's intent and the student's needs (Barrutia, 3, p. 37).

Far more than the first two abilities of the computer described above, this particular ability of the medium has been acknowledged widely for some time. Despite that circumstance, practically all of the CALL materials currently available force each and every student to go through them in the same, identical manner. Clearly, here too there is much to achieve before it can be said that adequate and appropriate use of the computer's potential as an instructional medium has been made.

Conclusion

Doubtless, too, there are other important qualities of the computer that have been passed over here—some of them perhaps as yet wholly unnoticed. For this reason, it is important to try occasionally to step back and

get a fresh perspective on what computers really are and what their potential is for any and all aspects of second-language acquisition. That may seem not so difficult, but it is not as easy as all that to assess such things accurately, as these words from Thomas A. Edison (5) testify.

> I believe that the motion picture is destined to revolutionize our educational system, and that in a few years it will supplant largely, if not entirely, the use of text-books in our schools. Books are clumsy methods of instruction at best, and often even the words of explanation in them have to be explained.
>
> I should say that on the average we get only about two percent efficiency out of school books as they are written today. The education of the future, as I see it, will be conducted through the medium of the motion picture, a visualized education, where it should be possible to obtain a one-hundred-per-cent-efficiency" (pp. 78–79).

If the "Wizard of Menlo Park" could be so wrong in his rosy assessment of the instructional potential of cinema, surely our own beliefs and pronouncements about CALL must be regarded with some skepticism.

Just as innovations and modifications in the cinema forced a reevaluation of that mediums' significance in our culture, so too our perception of the computer's potential will be altered by developments related to its own increasing power and declining costs, the development of higher-level computer languages, the use of interactive audio and video, improved speech recognition capabilities, and, most important, advances in the field of artificial intelligence. Exciting studies, such as MIT's Athena Project (Kramsch, Morgenstern, and Murray, 11) are underway to explore and help realize more of the computer's enormous potential for foreign language learning. But again, the process will be a slow one and will require active involvement on a broad scale.

> The emergence of motion pictures as a new art form went hand in hand with the emergence of a new subculture, a new set of professions made up of people whose skills, sensitivities, and philosophies of life were unlike anything that had existed before. The story of the evolution of the world of movies is inseparable from the story of the evolution of the communities of people. Similarly, a new world of personal computing is about to come into being, and its history will be inseparable from the story of the people who will make it (Papert, 16. p. 189).

What makes the development of CALL so exciting is the fact that, in this case, the people in the story are foreign language teachers. This is their

own new world that is coming into being, and it will be up to them to make its history.

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